

(DIY)biology and Opportunities for HCI

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ABSTRACT

Over the past decade, a diverse community of biologists, artists, engineers and hobbyists has emerged to pursue biology projects outside of traditional laboratories. Though still in its nascent form, this DIYbio (Do It Yourself Biology) movement has given rise to a host of technical innovations and sharing mechanisms that enable hobbyists to experiment with organic materials. As these developments continue to expand science practice beyond professional settings and into hackspaces, art studios and private homes, HCI research is presented with a range of new opportunities and concerns.

Our workshop will bring together a diverse group of designers and HCI researchers, as well as biologists, bioartists, and members of the DIYbio community to critically re-envision the role HCI might play at the intersection of biology, computation and DIY. This action-based one-day workshop will engage directly with DIYbio initiatives in the UK to explore the materials, practices and challenges of ‘garage biology’. Drawing on presentations from DIYbio participants who work with organic materials, hands-on biology activities (such as extracting DNA), and structured discussions, we hope to address themes such as: opportunities and implications for integrating organic materials into interactive systems; technologies that support and hinder public engagement with science; and HCI’s role in the public discourse around bioethics and biosafety.

Author Keywords

DIYbio, synthetic biology, DIY

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

A growing body of HCI and DIS research explores *citizen science* methods and applications that enable members of the general public to collect, analyze and act on scientific data [2]. From participatory sensing to health advocacy, food production and personal monitoring, novel DIY (do it yourself) tools and low cost technologies are emerging to support ‘science’ in the hands of non-experts. In this

workshop, we focus on DIYbio—Do It Yourself Biology—a movement that embraces biology (*science* in the most literal sense) outside of professional settings.

DIYbio has co-evolved with several ‘open source’ developments in synthetic biology, a bioengineering branch within biology. Initiatives such as OpenWetWare, a wiki-style collection of data and protocols [13], the Registry of Standard Biological Parts, a collection of genetic parts that can be assembled into biological systems [15], and the International Genetically Engineered Machine competition (iGEM) have enabled broader access to scientific information and materials [10]. Inspired by ideas of openness as applied to biology, hobbyists have coalesced into regional DIYbio groups, among them Genspace [8], a BSL1-certified open laboratory in New York City, IndieBiotech [9], a startup aimed at creating affordable biology tools for non-experts, and Manchester DIYbio [5], a group funded by the Wellcome Trust to further public engagement with science in the U.K., to name a few. DIYbio projects range from biosensors, genetic modification of organisms and experiments with food, to the creation of biology equipment from off the shelf parts. In parallel, bioartists around the world are incorporating organic materials into a variety of projects to explore the complex relationships between humans and biotechnology, and the emerging ethical issues. Examples include Zaretsky’s work with transgenic organisms [7], Dumitriu’s infective textiles [6], or the Critical Art Ensemble’s performative genetic experiments [3].

These distributed initiatives are supported by diybio.org, a forum boasting nearly 2000 members, “dedicated to making biology an accessible pursuit for citizen scientists, amateur biologists and biological engineers who value openness and safety” [4]. This forum invites professionals, artists and hobbyists to discuss issues from the practical (biology protocols and equipment exchange, *etc.*) to the more philosophical, such as questions of the ethics of tampering with nature. In addition, a number of low-cost kits that reproduce the functionality of lab equipment are now available for purchase and assembly, including OpenPCR [12], or Pearl Biotech’s open gel box [14].

Not surprisingly, the emergent ‘biohacking’ and ‘garage biology’ culture echoes some of the practices of previously studied DIY communities such as craft or electronics groups [1, 11, *etc.*]. DIYbio revolves around tinkering,

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'hacking', playing with and reconfiguring materials and systems. However, the materials worked with—living organisms, bio-electronic configurations and even parts of the human body—introduce a host of new challenges and opportunities for HCI and DIS research. These include novel techniques for 'crowdsourcing' biology experiments and visualizing data, bio-electronic configurations for working with organic materials, and design explorations to foreground the surrounding bioethical issues.

WORKSHOP DESCRIPTION

We propose a one-day workshop, focusing on the materials, practices, goals and challenges of the DIYbio movement. This workshop will bring together HCI researchers, designers, scientists, hobbyists and artists who are interested in or already working at the intersection of biology, technology and DIY. We will work directly with (DIY) biology practitioners, including bioartists and guest speakers from the DIYbio communities in Manchester and London. The workshop will be structured around several hands-on biology-related activities, which will be used to seed discussions about the role of HCI and design in this emerging space.

Goals

Our workshop will engage directly with DIYbio and bioartist communities. In doing so, we hope to gain unique insights into the day-to-day projects and materials of 'garage biology' practitioners, as well as the broader goals and implications of the DIYbio movement. In addition to participants' presentations of their work, we will explore DIYbio through a series of hands-on activities. Working directly with biology-related materials—both technological and organic—the workshop will expose the unique issues associated with pursuing biology outside of traditional laboratories. The workshop will thus present a venue for researchers, designers and practitioners to discuss the 'garage biology' movement and critically envision the emerging opportunities for interaction design research.

Our overarching goal is to explore a range of design issues at the intersection of biology, technology and DIY. We will consider issues from the practical challenges and opportunities for sharing knowledge across communities of professional biologists, DIY hobbyists and the general public, to the broader implications of incorporating organic materials into interactive systems and treating living organisms as inputs and outputs to digital technologies. Our workshop will also touch on the role HCI can play in foregrounding ethical and safety questions of 'redesigning' nature and placing biology in the hands of non-experts.

Themes

We hope to address the following themes through hands-on activities and collective brainstorming and discussions:

- *Goals and motivations.* What are the goals and motivations behind DIY biology? How do interactive systems support (or hinder) these?

- *DIYbio tools materials.* How are biomaterials acquired, repurposed and/or assembled? How do materials (their availability or lack thereof) shape DIY biology practices? How can novel technologies facilitate 'open access' to materials outside of professional labs?
- *Knowledge and expertise sharing.* What new mechanisms might enable knowledge sharing in biology laboratories (DIY or professional)? How can new forms of information be integrated into and/or shared during wetlab experimentation?
- *Challenges and constraints.* What are the challenges associated with DIYbio and how do communities work around them?
- *Public engagement.* What mechanisms and tools are used to engage members of the general public in biology projects? What new technologies might emerge to initiate dialogues between biology practitioners and stakeholders amongst the general public?
- *Ethics and safety.* How can HCI and design interventions be used to foreground questions of ethics and safety and facilitate public discourse around DIYbiology?
- *Bio-electronic hybrids.* What are the challenges and opportunities for interactive systems that incorporate organic materials as inputs and outputs?

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